OHANA DRONE MULTIPLE AIRCRAFT OPERATIONS SAFETY RISK MANAGEMENT (SRM) CASE

PURPOSE

The following Safety Risk Management (SRM) case is submitted as part of the mitigations Ohana Drone will incorporate during operations under their requested Petition for an Exemption to Conduct Unmanned Aircraft Systems (UAS) Operations Allowed by Special authority for certain unmanned aircraft systems. Title 49 U.S.C. § 44807, and 14 C.F.R. Part 11 to Authorize Commercial Agricultural- Related Services with UAS Weighing 55 Pounds or More.

This SRM is triggered for the proposed operations listed in the enclosed Petition for Exemption because Ohana Drone intends on operating **no more than two (2) DJI Agras T-16 aircraft** for aerial agricultural vegetation control and management operations in remote (rural), agricultural operating environments in class G uncontrolled airspace throughout the United States. The following are the mitigations Ohana Drone will incorporate to operate safely.

The multiple aircraft operation proposed in Ohana Drone's petition is not precedence setting as it is similar in nature to that currently conducted by Droneseed, Exemption No. 17936C, except that Ohana Drone only intends on safely operating no more than two (2) DJI T-16 aircraft, instead of five (5) that were approved for Droneseed. Moreover, Ohana Drone will be operating their (2) aircraft within VLOS instead of the EVLOS approved in the Droneseed request. The geographic environment that Ohana Drone will be operating in is also similar to that of Droneseed's sparsely populated, uninhabited operations. Ohana Drone will be flying over uninhabited farmland that they own, or uninhabited farmland they are contractually hired to spray. By contractual operations in concert with landowners, Ohana Drone can ensure that the property will remain clear during spray operations. Therefore, this operation is considered a summary grant. The T-16 aircraft have been previously approved by the FAA in numerous exemptions and is therefore also considered a summary grant. The following are the mitigations Ohana Drone will incorporate to operate safely.

The T-16 naturally provides different modes for flat ground, mountains, and orchards, to meet most operational needs. Up to five (5) T-16 aircraft can be controlled by a single remote controller simultaneously. **This enhances the efficiency of Ohana Drone's planned ultimate goal of a single-piloted operation of no more than two (2) aircraft.**

In order to safety implement that plan, initially, one or more visual observer(s) will be located at the ends of the field to assist the PIC in maintaining operational awareness.

Visual observers will be used for a minimum of 10 flight hours while assessing the efficacy of the software as well as the remote control.

The following is a list of potential hazards identified to substantiate their request. These mitigations are in addition to Ohana Drone current SMS Program (included with the Petition for Exemption), supported by various levels of policies and procedures that underline safety protocols throughout the company.

PROXIMITY AND RISK MANAGEMENT

When operating multiple aircraft, Ohana Drone will be employing two different methods of protecting persons in vehicles within or around the operations area, based upon a containment method and a probabilistic method. Both will be employed together in determining mitigations and control measures.

- The containment method will be within already low density remote sterile airspace and will include mitigations such as enhanced equipment and software, altitude, propulsion restrictions, geofencing, obstacle avoidance, and geographical alignment, The overall goal in containment methodology is to contain 100% of the UAS failure debris within this controlled area in the event a mishap occurs.

- The probabilistic Risk Assessment (PRA) is the process by which probability and severity of the hazards are defined for a specific operation. This results in a subjective expression of risk and is a structured and logical analysis aimed at identifying and assessing risks in complex technological systems. For example, the purpose of a PRA might include identifying and assessing Near Mid-Air Collision (NMAC) risk. The results provide an estimate of mission outcome likelihood and encounter probability with casualty expectation with other users of the airspace while the UAS is flying in a particular volume of airspace. Based on available design data, the process could identify major risk contributors rather than all possible risk contributors and apply estimates for those major hazard likelihoods to a set of scenarios. An example of an objective would be to estimate the probability that the UAS would successfully transit the proposed volume of airspace without encountering a vehicle at the same time within pre-determined criteria. The PRA process would use operational and functional system performance estimates, and their associated hazards, to evaluate the ability to mitigate risk.

SAFETY RISK MANAGEMENT ANALYSIS

An analysis of each of the hazards and outcomes identified in the chart below is provided in the following format with controls in accordance (IAW) FAA Order 8040.4B and FAA Order 8040.6 and provides information pertaining to each of the following elements of the operation along with strategic and tactical mitigations. These are the most standard and common hazards identified with any operation.

I. Aircraft
II. Airman/Operator
III. Airspace/Operating environment
IV. Emergency Procedures

Identify Hazards and Outcomes

Hazard Identified	Hazard Definition	Potential Causes	Existing Controls	Possible Outcomes
Technical Issue with UAS	Malfunction of a technical component of the UAS, which causes a deviation from planned operations.	• Motor failure • Software failure • Lost Link • GPS Failure • Battery failure • UA leaves planned route • UA fails to maintain lateral distance from the other UAs	• T-16 Redundant flight controls and flight controller allows for up to five (5) aircraft at once. • Onboard radar and signal redundancies • software enforced minimum lateral distance between aircraft of 40 feet • Competent PIC and flight crew trained and current in abnormal and emergency situations • Emergency procedures in place and validated • Lost-link safety default feature allows the UAS to automatically hover and land in response to a lost-link event. • Failsafe RTH • UAS maintained IAW all manufacturer maintenance procedures and remains in a flight ready condition • Preflight checks of UAS for every	• Collision between UAS and a manned aircraft in the air • Collision between a UAS and person on ground or moving vehicle • Collision between a UAS and critical infrastructure on the ground

			mission ● UAS manufactured by competent or proven entity ● Restricted by speed; reduced kinetic energy ● Restricted by altitude ● Operations over rural uninhabited, private or restricted-access land ● T-16 Intelligent flight battery with reserve battery power ● Flight limits and Geofencing zones ● PIC required to give way to all other manned aircraft	
Deterioration of external systems supporting the UAS operation	Malfunction of any component that is not a part of the UAS but supports safe operations.	● GPS signal degradation ● Ground station Malfunction ● Communication malfunction between PIC and VO	● Built in signal redundancies ● Smart and failsafe RTH features ● Manual RC override control features for the PIC ● RTK GPS-Should a telemetry link to the base station be lost, the UA has all mission parameters stored onboard, and can safely continue to execute a mission. ● Redundant GPS ● GPS warning/indicator lights ● PIC will follow the procedures outlined in the aircraft operator's manual for GPS failure ● UAS is designed to manage the deterioration of external systems supporting the UAS operation ● PIC follows lost link protocols ● PIC will always give way to all manned aviation operation and activities. ● Competent PIC trained and current in abnormal and emergency situations ● UA equipped with Kill switch	● Collision between UAS and a manned aircraft in the air ● Collision between a UAS and person on ground or moving vehicle ● Collision between a UAS and critical infrastructure on the ground
Human Error (Human Factor)	A person's mistake rather than the failure of a machine, causing a deviation from planned operations.	● Pilot error ● Maintenance Errors ● Preflight Planning Errors ● Mission and route planning errors ● Flight into unplanned weather	● PIC and all crewmembers are trained and current with complete knowledge of the regulations, limitations, restrictions under which they operate as a Part 107 certified remote pilot. ● Multi-crew coordination and VO with instant communications with the PIC ● UAS maintained IAW manufacturer procedures and remain in a flight ready condition ● Multiple Aircraft Capability built into the software ● Preflight procedures in place and validated ● Crew fit to operate – comply with drug and alcohol provisions of §§91.17 and 91.19	● Collision between UAS and a manned aircraft in the air ● Collision between a UAS and person on ground or moving vehicle ● Collision between a UAS and critical infrastructure on the ground

			• Automated protection of the flight envelope from human error • Crew resource management IAW FAA AC 120-51, or accepted equivalent adhered to • Sterile cockpit procedures adhered to • Flights in VMC conditions only • Failsafe RTH feature • Automatic Continuous aircraft lighting • Redundant flight controls and safety features	
Adverse Operating Conditions	Operating into or within conditions that the UAS wasn't intended to, which causes a deviation from planned operations.	• Un-forecasted weather • Reduced visibility • Climate and topography unique weather	• Operations in VMC conditions with at least 3 miles visibility and 1500-foot ceiling adhered to • The PIC and any aircrew are trained to identify critical environmental conditions and to avoid them to maintain VLOS at all times • Environmental conditions for safe operations are defined, measurable and adhered to • UAS designed and qualified for adverse environmental conditions including temperature and wind accountabilities • PIC will immediately discontinue operations if VLOS cannot be maintained with all aircraft • PIC will always give way to all manned aviation operation and activities. • Conspicuity of the aircraft with continuous lighting	• Collision between UAS and a manned aircraft in the air • Collision between a UAS and person on ground or moving vehicle • Collision between a UAS and critical infrastructure on the ground
Unable to Maintain VLOS	Inability to maintain VLOS with the UAS causing a deviation from planned operations.	• Communication failure between VOs • Traffic conflicts; helicopter routes/uncharted landing surfaces • Inability to comply with 14 CFR Parts §91.113 and §107.37 • Unexpected Low altitude General Aviation (GA) Operations	• Effective two-way communications between VO and PIC procedures adhered to • PIC and VOs properly trained in §§ 91.111, 91.113, and 91.115, and 107.37 • PIC and VO positioned at visual vantage points in the operations area • Time of day operating restrictions • Restricting operations within certain boundaries or airspace volumes • Restricting operational flight time • Altitude restricted • Low altitude and proximity to certain structures; prohibits manned flights • Flight termination in the event the PIC or a VO is unable to maintain VLOS with the UAS during flight • PIC will always give way to all manned aviation operation and activities. • Conspicuity of aircraft with continuous lighting	• Collision between UAS and a manned aircraft in the air

I. AIRCRAFT

A. AIRCRAFT SAFETY FEATURES

1. Initial Airworthiness Review

In additional to the FOPM, all UAS operations will be conducted in accordance with (IAW) the DJI AGRAS T-16, operating manuals. Aircraft will always be operated, in a flight ready condition, and aviation personnel are expected to utilize sound, conservative judgment in their approach to their duties.

In accordance with the statutory criteria provided in 14 CFR part 107, and in consideration of the size, weight, speed, and limited operating area associated with the aircraft and its operation, Ohana Drone expects no adverse safety affects to participating or nonparticipating individuals compared to a manned aircraft that holds a standard airworthiness certificate performing a similar operation.

Ohana Drone has an established inspection and maintenance program for the continued airworthiness of the aircraft in accordance with the manufacture's maintenance, overhaul, replacement, inspection and life limit requirements for the aircraft and aircraft components.

2. Redundant Flight Controls

I. The DJI AGRAS T-16 has an unprecedented safety rating. DJI has an unparalleled presence in the UAS market with steadfast commitment to R&D, a culture of constant innovation and curiosity, and a focus on transforming complex technology into easy-to-use devices. Building on the ethos of "form follows function," DJI products combine advanced technology with dynamic designs.

Established to produce DJI's innovative products safely and responsibly, the wholly owned subsidiary Shenzhen Dajiang Baiwang Technology Co., Ltd. is a high-tech manufacturing facility specializing in unmanned aerial vehicles.

In 2016, Dajiang Baiwang passed the ISO 9001:2015 Quality Management System Certification and in 2017 passed the SGS ISO 14001:2015 Environmental Management System Certification.

DJI's offices can now be found in the United States, Germany, the Netherlands, Japan, South Korea, Beijing, Shanghai, and Hong Kong. As a privately owned and operated company, DJI focuses on its vision, supporting creative, commercial, and nonprofit applications of their technology.

Today, DJI products are redefining industries. Professionals in filmmaking, agriculture, conservation, search and rescue, energy infrastructure, and more customers trust DJI to bring new perspectives to their work and help them accomplish feats safer, faster, and with greater efficiency than ever before.

To date, sales of the DJI Agras T-16 have occurred in Japan and China for over a year with a combined total of 5,856,935 hours flown without any recorded incidents. The T-16 has an aerial-electronics system with a multiple redundancy design, and also has onboard D-RTK antennas, supporting dual-antenna technology that provides strong resistance against magnetic interference to ensure flight safety.

The DJI AGRAS T-16 has onboard safety features to ensure the UAS can operate safely under both normal and contingency operating conditions. These features include automation to increase safety and reduce pilot workload. Some examples are the self-monitoring function (pre-takeoff diagnostics), a high-precision altitude control system, and redundant GPS flight control systems with geo-fencing and active obstacle avoidance. The lost-link safety default feature allows the DJI AGRAS T-16 to automatically hover and land in response to a lost-link event. Safety features such as the GPS warning/indicator lights and speed indicator light provide critical system status information to the pilot.

The T-16 also has also been tested in unfavorable weather conditions to include high winds and a variety of terrains and no failures have been reported

Aircraft performed well with no loss of communications, no issues with stability, or control and handling. Performance of all safety features work as designed.

Multiple Aircraft Capability - The T-16 provides different modes for flat ground, mountains, and orchards, to meet most operational needs. Up to five (5) T-16 aircraft can be controlled by a single T-16 remote controller simultaneously, doubling the efficiency of Ohana Drone's planned single-pilot operation of no more than two (2) aircraft.

In order to safety implement that plan, initially, one or more visual observer(s) will be located at the ends of the field to assist the PIC in maintaining operational awareness.

Visual observers will be used for a minimum of 10 flight hours while assessing the efficacy of the software as well as the remote control.

Onboard Radar - The T-16's upgraded radar system can sense the operating environment during the day or at night, without being affected by light or dust. It has greatly improved flight safety with forward and backward obstacle avoidance and a horizontal FOV (field of view) of 100°, double that of previous DJI AGRAS agricultural drones. It can also detect the angle of a slope and adjust to it automatically even in mountainous terrain. This innovative radar system adopts Digital Beam Forming (DBF) technology, which supports 3D point cloud imaging that effectively senses the environment and helps to circumvent obstacles.

Signal Redundancies - The all-new modular aerial-electronics system in the T-16 has dual IMUs and barometers and adopts a propulsion signal redundancy design to ensure flight safety. The GNSS+RTK dual-redundancy system supports centimeter-level positioning. It also supports dual-antenna technology that provides strong resistance against magnetic interference.

P-mode (Positioning): The aircraft utilizes GNSS or the RTK module for positioning. When the GNSS signal is strong, the aircraft uses GNSS for positioning. When the RTK module is enabled and the differential data transmission is strong, it provides centimeter-level positioning. The aircraft reverts to A-mode when the GNSS signal is weak. The aircraft will fly in P-mode by default.

Rotor Fail Protection - If one rotor fails, the flight controller will compensate for lost rotor and will notify operator via on-screen warnings; aircraft maintains stability allowing operator to safely land

Return-to-launch (RTL) - . There are two types of RTH: Smart RTH and Failsafe RTH.

Smart RTH

When GNSS is available to enable Smart RTH, the speed and altitude of the aircraft can be controlled when returning to the home point. The aircraft status indicators will show the current flight mode during RTH. Press the RTH button once or toggle the pause switch to exit Smart RTH and regain manual control of the aircraft.

Failsafe RTH

Failsafe RTH is automatically activated if the remote controller signal is lost for more than three seconds, provided that the home point has been successfully recorded, and the GNSS signal is strong and the RTK module is able to measure the heading of the aircraft. The RTH continues if the remote controller signal is recovered, and users can control the aircraft using the remote controller.

There are two ways to set a home point:

1. Set the current coordinates of the aircraft as the home point.

2. Set the current coordinates of the remote controller as the home point.

Obstacle Avoidance During RTH

Obstacle avoidance during RTH is also available. If there is an obstacle Within 20 m of the aircraft, the aircraft decelerates and then stops and hovers. If the aircraft comes within 6 m of the obstacle while decelerating, the aircraft stops, flies backward, to a distance of approximately 6m from the obstacle, and hovers. The aircraft exits the RTH procedure and waits for further commands.

DBF Imaging Radar: The all-new DBF imaging radar works during both day and night, without being affected by light or dust. The radar module can predict the distance between the aircraft and the vegetation or other surfaces in forward, rear, and downward directions to fly at a constant distance to ensure even spraying and terrain following capability. The DBF imaging radar can also detect obstacles 30 m away from the aircraft. The radar module adopts digital beam forming technology, which supports 3D point cloud imaging that effectively senses the environment and helps to circumvent obstacles in both Route and A-B Route operation modes. In addition, radar module limits the descent speed of the aircraft according to the distance between the aircraft and ground, to provide a smooth landing.

The altitude stabilization and obstacle avoidance functions of the radar module are enabled by default and the obstacle avoidance function can be used in any mode. Auto Bypass is disabled by default.

Reserve Power: The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power to conduct the intended operation with sufficient reserve such that in the event of an emergency, the PIC can land the aircraft in a known area without posing an undue risk to aircraft or people and property on the ground. In the alternative, if the manufacturer’s manual, specifications, or other documents that apply to operation recommend a specific volume of reserve power, the PIC will adhere to the manufacturer’s recommendation, as long as it allows the aircraft to conduct the operation with sufficient reserve and maintain power to land the aircraft in a known area without presenting undue risks, should an emergency arise.

2600W 4 Channel Intelligent Battery Charger

Up to four batteries can be charged simultaneously. When using the single-channel quick charging mode, a full charge only takes 20 minutes, a 50% increase in speed from the previous generation. The charger has a built-in battery health management system that monitors critical data in real time, such as voltage and temperature, to ensure charging safety.

T-16 Intelligent Flight Battery

The T-16 Intelligent Flight Battery has a capacity of 17,500 mAh and a 14S high voltage system that reduces power consumption. It is designed with an IP54-rated all-metal housing, and heat dissipation efficiency has increased by 140% from the previous generation. Supported by cell-balancing technology, the battery has an increased charging cycle of up to 400, 100% higher than the previous generation.

Emergency brake and return-to-launch (RTL) - The operator has systems that they can use to instantly stop the UA and return it to the base point at a predetermined safe height, respectively.

Beacon - In the extremely unlikely event of a system malfunction that causes a crash, a beacon attached to the UA will help the PIC and ground crew quickly locate it, ensuring a quick response to secure the equipment and surrounding area.

RTK GPS - The UAS has a telemetry link to a base station which makes GPS corrections, giving the UA an accurate location reading with under 3 feet of precision. (Typically, 50cm). This ensures that the UA is flying the missions it is given and applying herbicides in a pattern much more efficiently and consistently than agricultural helicopters.

Redundant GPS- All UAS are equipped with redundant GPS units. Should the primary GPS unit experience a failure, a second GPS unit will automatically take over as a failsafe to ensure accurate positioning and navigation is maintained. Full dual redundancy, automatic switching in real-time between compass, IMU, GPS or controller if one fails.

Telemetry - Should a telemetry link to the base station be lost, the UA has all mission parameters stored onboard, and can safely continue to execute a mission. If the RTK link is dropped, the positioning accuracy may drop to around 3m accuracy. Audio alerts on the RC remote and base station computer will alert the PIC, who may opt to allow the UA to continue its mission if it is safe to do so or interrupt the mission and bring the UA back under RC control.

System Data Protection: In Route or Route A-B operation mode, the System Data Protection feature enables the aircraft to retain vital system data such as operation progress and breakpoints after the aircraft is powered off to replace a battery or refill the spray tank.

During Route operations, in situations when the remote controller disconnects from the aircraft, the breakpoint will be recorded by the flight controller and can be recovered in the app once the aircraft is reconnected.

Geofencing and Obstacle avoidance - The UA's flight controller is given GPS coordinates of a boundary that it cannot leave, keeping the UA from leaving the pre-determined and defined operations area. When enabled, the UA can "hit" the perimeter, but not fly past or through it. Manual or automatic inputs commanding the UA to break the geofence are ignored. In the case where there is a road along the property line, or a place where a neighbor's property is located, the operator can use the Ground Station Google Maps interface and draw a line around the field. This is a perimeter that the drone will not fly outside of. If the operator were to try to fly beyond that boundary, the aircraft would approach the line and stop and hover.

Second, for an obstacle, other property, or people, and purposeful obstacle boundary can be established. This means that the aircraft will build its flight plan and avoid that obstacle. Further, the operator can specify how large of a buffer they would like to keep between the aircraft and that obstacle.

As a reminder, if there was ever a time where a non-participant person or property entered the planned flight area, the operator could immediately halt the operation by activating the emergency "kill switch" to immediately stop the rotors or may press a switch to activate the emergency return to home feature.

RC control - All missions occur with pre-programmed commands providing instructions to the UA. At all times, a PIC has an RC remote with the ability to override the current mission. Should the RC connection be lost, the autopilot software will immediately end the mission and return the UA to the home launch location. In this case, the UA ascends to a height set by the PIC in advance of the mission and determined to be safe given the surrounding terrain, normally 30-40 feet. The UA then returns in a straight line to the launch location. The PIC may choose to resume or alter the mission if an RC link is established again while the UA returns home.

Emergency Kill Switch - An emergency "Kill Switch" allows the operator to instantly stop motors in the event of an emergency.

II. Additional Safety Functions

Additional supplemental safety information is provided below to strengthen the petitioner's position that the proposed UASs can be operated safely in the NAS in accordance with Title 49 U.S.C. § 44807. The DJI AGRAS T-16 has an unprecedented safety rating with 0 reported injuries or fatalities during customer use and or testing.

Flight Recording of all flights: Flight data shows a real-time video of all operator control input, GPS statuses, vibrate, shake and motor balance statuses along with battery voltage and all other critical telemetry data allowing operator to fully track entire history. All flights are automatically saved on the GCS. This further adds to safety for operator and VO training as operator-caused issues can be quickly identified.

High Visibility LED Aviation Lighting: The T-16 has Long-range visible, high intensity LED lighting. All T-16 come with mounted navigation lights in a standard configuration to indicate orientation and health. DJI Agras offers optional Long-range visible, high intensity LED strobes. Back 4 are white. Front right are green. Front left are red. Further, the use of high-visibility paint will be used on the aircraft to increase conspicuity in order to facilitate rapid identification of the UAs.

Safety parameters: altitude, distance from home, horizontal speed and vertical speed: defaults are set by DJI AGRAS, and the customer can set these as well based on location and operating restrictions.

Intelligent Assisted Launch and Landing: Aircraft uses GPS and IMU data to determine when the craft is fully on the ground, meaning the craft will not shut rotors off until firmly on the ground. Aircraft also uses IMU data to safely and smoothly handle “In Ground Effect” caused by the rotor downwash, which lessens stress and accident likelihood for operator.

Take Off and Landing Points of multiple UAS will be at least 40 ft apart. This is Software enforced. In addition, only one (1) UAS will take off and land at a time. Takeoff and landings will be staggered so that the pilot can focus on the drones actively taking off or landing.

No missions for any UAS will ever be assigned that will cause crossing of flight paths. Each UAS will be the closest UAS to its own mission area.

UAS RTL points will never be within 10 feet of each. This is to ensure that a collision on landing will not occur and it is also software enforced.

Flight Stall Prevention: Flight controller prevents accidental 'throttle zero' motor stall while in the air. In an emergency, operator can switch instantly to 'manual' mode to activate rotor kill, providing complete system override by the pilot during an in-flight emergency.

Semi-Automatic Navigation: Allows operator to manually override aircraft speed and altitude instantly during automatic Ground Station controlled flights.

Auto-lock rotors: Automatically locks rotor from accidental turning after initial power connected and again five seconds after rotors stop. The customer can also require a password be entered on the GCS to prevent unauthorized flights.

Change of Flight Parameters: Ability to change parameters in real-time (during flight).

Flight Controller Modifications: Ability to program, calibrate, debug, and modify flight controller information without power to rotors: allows safe physical interaction with UA while performing maintenance and servicing.

Return to Home Features: In the event that the original “home” location is no longer safe to return to, the PIC can execute a command to immediately, and automatically land the aircraft at its current location.

3. Speed Restrictions

a. Restricted by Speed: During multiple operations, the T-16 will be operated at a reduced airspeed not exceeding 20 miles per hour or at an airspeed greater than the maximum operating airspeed recommended by the aircraft manufacturer, whichever is lower.

II. Airman/Operators

A. Crew Member Roles and Responsibilities

1. Pilot in Command (PIC)

The PIC is the holder of a remote pilot certificate with a UAS rating and satisfies the aeronautical knowledge currency requirements of 107.65.

The PIC is responsible for halting or canceling activity in the operations area if, at any time, the safety of persons or property on the surface or in the air is in jeopardy.

The PIC shall have successfully completed the training and qualification process as specified in the DJI AGRAS T-16, User's Manual. Specific attention will be given to the multiple aircraft operations section and all procedures will be followed. PIC qualification flight hours and currency will be logged in a manner consistent with 14 CFR § 61.51(b). Duties include, but are not limited to:

- checking weather and all applicable NOTAMs where available;
- determining the aircraft weight and balance IAW payload and airframe requirements;
- ensuring that all flight planning requirements have been met;
- ensuring that the aircraft is duly registered and that the documentation is available for inspection at the Ground Control Station;
- ensuring that aircraft crew members have valid licenses, medical certificates, and are qualified for the mission to be flown;
- completing an aircraft pre-flight inspection before each departure;
- briefing the crew members;
- operating the aircraft in accordance with operator procedures and aircraft limitations IAW the aircraft operators manual;
- completing all post flight duties and recording flight times and aircraft defects.

PIC AUTHORITY

The PIC of a flight is directly responsible for, and is the final authority as to the safe, effective, operation of the aircraft and the well-being of the crew (Ref 14 CFR part 91.3). Deviation from specified flight and operating instructions is authorized during an in-flight, emergency situation, when in the judgment of the PIC, safety justifies such action.

Responsibility for starting or continuing flight with respect to weather or any other condition affecting the safety of the aircraft rests with the PIC. The PIC is vested with the final decision regarding the aircraft's airworthiness and safe conduct of the flight. In the case of a mishap to an aircraft, the PIC is responsible for its safe custody until the aircraft has been taken into custody by proper authority IAW National Transportation Safety Board (NTSB) Title 49 Subtitle B Chapter VII Part 830 and all other FAA requirements.

2. Visual Observer (VO)

All Ohana Drone flight operations will initially utilize a VO. Visual observers will be used for a minimum of 10 flight hours while assessing the efficacy of the software as well as the remote control. The PIC will always maintain VLOS capability but initially, one or more visual observer(s) will be located at the ends of the field to assist the PIC in maintaining operational awareness. When the VO(s) are required, the VO and the PIC will maintain effective two-way communication and will coordinate with one another to scan the airspace where the UAS are operating for any potential collision hazard and will both maintain operational awareness of the position of the UAs.

If the PIC is unable to maintain VLOS with a UA during flight, the entire flight operation will be terminated as soon as safely practicable. The VO(s) will be positioned to assist the PIC, to exercise the see-and-avoid responsibilities required by §§ 91.111, 91.113, and 91.115 by scanning the area around the aircraft for potentially conflicting traffic and assisting the PIC with navigational awareness. Visual Observers:

- Are required for all operations.

- Must have a thorough understanding of FAA regulations for the airspace where the UAS will be operating.
- Must be responsible for only one UAS at a time.
- Must maintain immediate communication with the UAS pilot, at all times. The observer must also monitor the appropriate ATC frequency when required, to enhance situational awareness.
- Must assist the PIC with maintaining the UAS within VLOS.
- Must be in position to observe the aircraft and the surrounding airspace to assist the pilot in determining:
  - The UAS's proximity to other airborne assets (participating and non-participating aircraft) and physical hazards (towers, structures, weather).
  - Prevent the UAS from becoming a collision hazard.
- Must inform the PIC prior to losing visual contact.
  - This is based on the VO's normal vision, however, corrective lenses, glasses, and contact lens are allowed. Binoculars, telephotos lens, night vision goggles, and field glasses are allowed as augmentation devices, but cannot be used as the primary means of visual contact.
- All supported operations will be conducted in Visual Metrological Conditions (VMC).
- Be trained in:
  - Crew Resource Management (CRM), FAA AC 120-51 or accepted equivalent.
    - The observer must bring any information that has an impact on operational safety and/or the safety of the mission to the attention of the PIC. The observer should convey the information clearly, giving appropriate detail in a concise, organized manner, and to state recommendations as appropriate. The observer should be prepared to respond to questions and ask questions if needed to clarify any instructions given by the PIC.
  - Applicable sections of CFR 14 (91.111, 91.113, 91.115, and 91.155).
  - ATC and pilot radio phraseology.
  - Applicable sections of the Aeronautical Information Manual (AIM).

Other Flight Crew

Ancillary personnel such as sensor operators or other specialists must be thoroughly familiar with and possess operational experience of the equipment being utilized in accordance with the operator's manual.

Crew Resource Management

The goal of Ohana Drone UAS program is to provide safe, efficient, consistent, and reliable utilization of aviation assets for the public. The aircrew members and observers are uniquely positioned and qualified to ensure that these goals are met for each and every flight. Experience has shown that a well- managed flight deck/cockpit environment, including the timely and correct exchange of information between crewmembers and the proper accomplishment of their appointed tasks, serves as one of the most effective methods by which operational safety can be enhanced. All UAS crewmembers will be trained in CRM and the PIC will ensure that all aircrew members integrate crew risk management. The current edition of FAA AC 120-51, Crew Resource Management Training, or recognized equivalent, is applicable.

Sterile Cockpit

During critical phases of flight, no crewmember may perform any duties not required for the safe operation of the aircraft. No crewmember may engage in, nor may any PIC permit, any activity during a critical phase of flight, which could distract any crewmember from the performance of his/her duties or interfere in any way with the proper conduct of those duties.

III. Airspace/Operating Environment

A. Airspace Description

Ohana Drone operations will be conducted within the Contiguous United States, during Visual Meteorological Conditions (VMC) conditions, in Class G uncontrolled airspace only and no portion of the flight will occur in Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless a specific airspace authorization is received through an amended Petition for Exemption approved by the FAA.

Notice to Airman (NOTAMs)

The PIC will request a Notice to Airman (NOTAM) not more than 72 hours in advance, but not less than 48 hours prior to each operation. The NOTAM will contain the following information:

- Name and address of the pilot filing the NOTAM request.
- Location, altitude, and/or operating area.
- Time and nature of the activity.
- Number of UAS flying in the operating area.

The area of operation defined in the NOTAM will only be for the actual area to be flown for each day and defined by a point and the minimum radius required to conduct the operation.

The PIC will cancel applicable NOTAMs when UAS operations are complete or will not be conducted.

Coordination Requirements

Operators and UAS equipment will meet the requirements (communication, equipment, and clearance) of the class of airspace within which the UA will operate. In this case, it will be class G uncontrolled airspace.

PIC filing and the issuance of required distance (D) NOTAM will serve as advance ATC facility notification for UAS operations in an area.

1. Site Selection and Operational Procedures

Ohana Drone operations will occur in a closed access environment over rural uninhabited, unoccupied, private or restricted-access land. These operating areas will always be owned or managed by the person or entity that is contracting with Ohana Drone to perform the aerial application and will be planned and approved in advance of the mission.

Due to the contractual nature of the operations with landowners, no other manned crop spraying operations will occur during Ohana Drone flight operations. Further, there are areas of airspace associated with UAS operations where normal manned aircraft cannot fly. However, the PIC will remain clear and give way to any unexpected manned aviation operations and will immediately land the UAS until the manned aircraft has exited the operations area.

Operational Obstacles and Boundaries

Prior to conducting flight operations, the PIC will identify any operational area obstacles and boundaries, so to avoid collision with, or damage to property. Ohana Drone will visit the area of planned operation and inspect the terrain and vantage points prior to operations. Ohana Drone utilizes a number of tools available to capture this environmental data, including high-resolution photogrammetry, and handheld surveying tools. The result is a geo-rectified model of the unit, with GPS points accurately marking the boundaries of the geofenced flight operating area.

Controlled Access

Ohana Drone operations will occur under strictly controlled conditions in predetermined class G airspace that is, 1) Limited in scope 2) Controlled as to access by mission essential personnel only. Ohana Drone will be flying over uninhabited farmland that they own, or uninhabited farmland they are contractually hired to spray. By contractual operations in concert with landowners, Ohana Drone can ensure that the property will remain clear during spray operations. In addition, signage announcing future spraying operations will be posted at the site entrance warning any customer employees or non-Participants that an aerial spraying operation is occurring. This is an industry standard process.

Non-participating Personnel

Additionally, restricted physical access, early notifications of proposed flight operations, and perimeter monitoring will be conducted in a manner to restrict access by non-participating personnel. To further ensure the area of operation is clear of all non-Participants and any other potential hazards, prior to beginning agricultural operations, a single UAS will be used to survey and access the operating environment.

All personnel at the site will be controlled by Ohana Drone at the time of flying. The T-16 aircraft shall operate from on-site takeoff/landing locations directly next to the PIC and co-located VO. When using 2 or more UAS on the same field, they will start on similar sides of the field to avoid collision, but will always be at least 40 ft apart.

The PIC and the VO will be able to verbally communicate during all operations or will utilize hand-held radios on site. In addition, signage announcing future spraying operations will be posted at the site entrance warning any customer employees or non-Participants that an aerial spraying operation is occurring. This is an industry standard process.

Altitude Restrictions

Spraying operations will generally be conducted at an altitude of between 15-25 feet AGL but will never be higher than 100 feet AGL even during return to home or safety maneuvering. This vertical height limit is a set restriction in the software and cannot be exceeded or changed during flight. Flying at these low altitudes increases the aircraft's efficiency, without posing any increased risk to people or property.

IV. EMERGENCY PROCEDURES

A. Lost Link

A lost-link safety default feature allows the UAS to automatically hover and land in response to a lost-link event. Safety features such as the GPS warning/indicator lights and speed indicator light provide critical system status information to the pilot.

The Ohana Drone pre-programmed emergency procedures also incorporate contingency plans that address emergency recovery or flight termination of the UAS in the event of unrecoverable system failure.

These procedures will normally include Lost Link Points (LLP), Divert/Contingency Points (DCP) and Flight Termination Points (FTP) for each operation.

The PIC will immediately abort the flight operation if unexpected circumstances or emergencies arise that could degrade the safety of persons or property. The PIC will terminate flight operations without causing undue hazard to persons or property in the air or on the ground.

When required, the PIC will also notify local ATC of any in-flight emergency or aircraft accident as soon as practical.

B. Manual Control

If at any time there is a question that the UAS is no longer flying its programmed mission, the PIC will take manual control of the UAS and return it to the landing zone immediately under manual control. There may be minor problems that do not require emergency assumption of control. In these cases, the PIC can direct an autopilot landing or manually land the aircraft.

1. Flyaway

In the highly unlikely event of a flyaway, The PIC will immediately initiate RTH protocol or land the second aircraft without causing undue hazard to persons or property in the air or on the ground. At the same time, the PIC will immediately terminate flight operations of the flyaway aircraft without causing undue hazard to persons or property in the air or on the ground.

The Failsafe RTH is automatically activated if the remote controller signal is lost for more than three seconds, provided that the home point has been successfully recorded, the GNSS signal is strong (the white GNSS icon), and the RTK module is able to measure the heading of the aircraft. The RTH continues if the remote controller signal is recovered, and the pilot can control the aircraft using the remote controller.

C. Lost Communications

1. Loss of Communications between the Observer and the Pilot in Command

When a VO is used, communications between the PIC and VO will be through direct communication when possible. However, when the observer and the PIC are not co-located where verbal communication is possible, the following communication tools will be utilized….

- Hand held Police radio
- Voice actuated headsets
- Cellular phone
- Hand Signals (may be used solely or in conjunction with the communication equipment)

If communication is lost and cannot be re-established the UA will immediately land.

2. Between the UAS and GCS

If there is a temporary loss of control of the UAS due to a lost communication link with the GCS, the UAS will respond to the failsafe mode IAW design specifications established in the aircraft operator's manual. The PIC will perform the procedures identified in the Ohana Drone Operations Manual.

GPS Failure

If there is a GPS failure and the returning telemetry from the UAS indicates as such, the PIC will follow the procedures outlined in the aircraft operator's manual.

Hazard	Severity	Likelihood
#1 Technical Issue with UAS	Major 3	Remote C
#2 Deterioration of external systems supporting the UAS operation	Minor 4	Remote C
#3 Human Error	Minor 4	Remote C
#4 Adverse Operating Conditions	Major 3	Remote C
#5 Unable to maintain VLOS	Major 3	Remote C

Assess safety Risks

Hazard	Initial Risk Level	Rationale
#1 Technical Issue with UAS	Medium (3C)	The severity is determined to be **Major** based that Ohana Drone operations will occur under strictly controlled conditions in predetermined class G airspace that is, 1) Limited in scope 2) Controlled as to access by mission essential personnel only. Due to the contractual nature of the operations with private landowners, no other manned crop spraying operations will occur during Ohana Drone flight operations. Further, there are areas of airspace associated with the UAS operations where normal manned aircraft cannot fly due to the proximity to the ground and potential structures. With the added mitigations in place the likelihood is determined to be **extremely remote**. The DJI AGRAS T-16 is equipped with redundant flight controls and transmission systems that are adequate to maintain simultaneous control of the UAS, so they remain inside the operations area. Additional sophisticated and effective Geo fencing is also in place for containment and the proven DJI AGRAS T-16 technologies to date. It also employs Multiple Aircraft Capability. The T-16 provides different modes for flat ground, mountains, and orchards, to meet most operational needs. Up to five (5) T-16 aircraft can be controlled by a single T-16 remote controller simultaneously, doubling the efficiency of Ohana Drone's planned single-pilot operation of no more than two (2) aircraft. During multiple operations, the T-16 will be operated at a reduced airspeed not exceeding 20 miles per hour or at an airspeed greater than the maximum operating airspeed recommended by the aircraft manufacturer, whichever is lower. Take Off and Landing Points of multiple UAS will be at least 40 ft apart. This is Software enforced. In addition, only one (1) UAS will take off and land at a time. Takeoff and landings will be staggered so that the pilot can focus on the drones actively taking off or landing. No missions for any UAS will ever be assigned that will cause

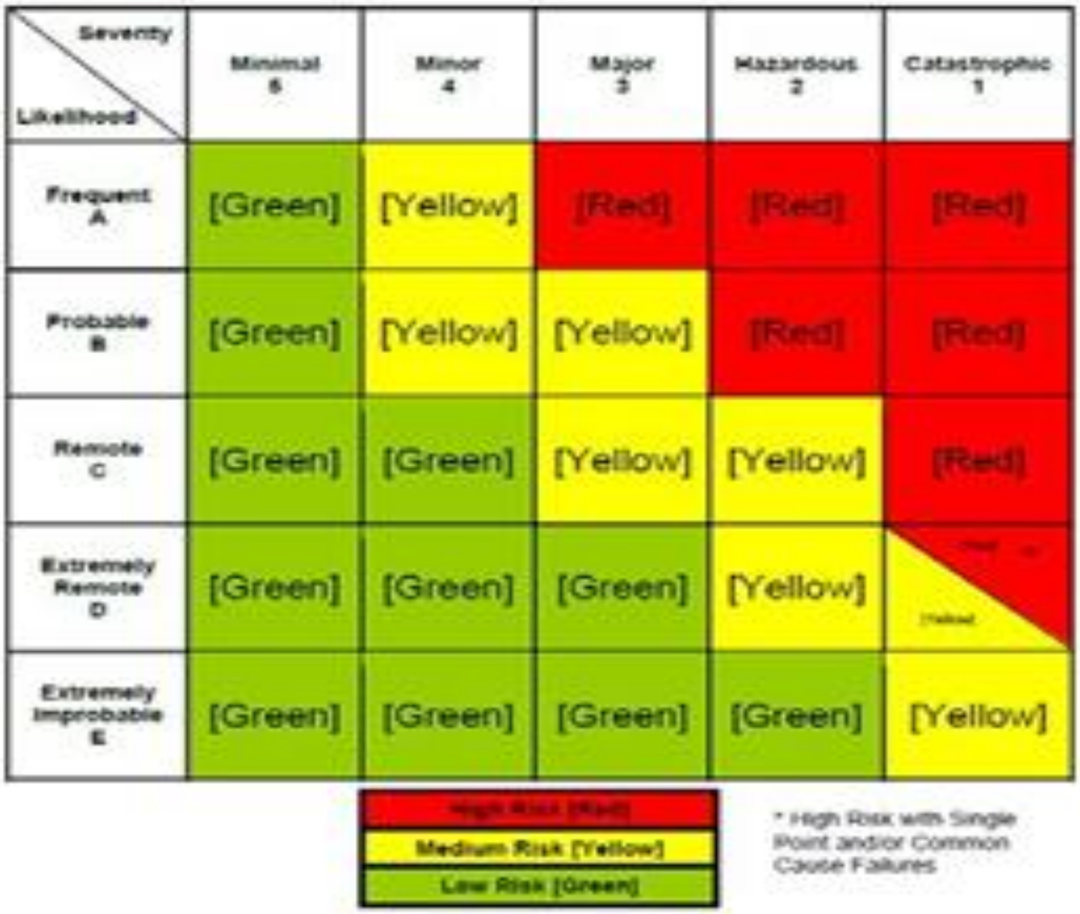
		crossing of flight paths. Each UAS will be the closest UAS to its own mission area. UAS RTL points will never be within 10 feet of each. This is to ensure that a collision on landing will not occur and it is also software enforced. In the highly unlikely event of a flyaway, The PIC will immediately initiate RTH protocol or land the second aircraft without causing undue hazard to persons or property in the air or on the ground. At the same time, the PIC will immediately terminate flight operations of the flyaway aircraft without causing undue hazard to persons or property in the air or on the ground. The Failsafe RTH is automatically activated if the remote controller signal is lost for more than three seconds, provided that the home point has been successfully recorded, the GNSS signal is strong (the white GNSS icon), and the RTK module is able to measure the heading of the aircraft. The RTH continues if the remote controller signal is recovered, and the pilot can control the aircraft using the remote controller.
#2 Deterioration of external systems supporting the UAS operation	Low (4C)	The severity is determined to be **minor** based on the UAS being designed from the manufacturer to manage the deterioration of external systems supporting the UAS operation. With the added mitigations in place, the likelihood is **extremely remote.** Manual control features allow PIC to immediately return to landing zone and the aircraft is equipped with GPS warning/indicator lights. The UAs are also equipped with redundant GPS units. The PIC will follow the procedures outlined in the aircraft operator's manual for GPS failure and in the event of complete communications failure, the PIC will immediately land the UASs and abort the mission.
#3 Human Error	Low (4C)	The severity is determined to be **minor** based on all crewmember's initial and recurrent training with a complete knowledge of the regulations, limitations, restrictions under which they operate as a Part 107 certified remote pilot and Part 137 certified agricultural operators. UASs will be maintained IAW manufacturer procedures and remain in a flight ready condition. With the added mitigations in place, the likelihood is **extremely remote.** Team checklists IAW Ohana Drone training manual and the FOPM will be adhered to and all crew members are trained and fully knowledgeable in crew resource management. The sophisticated and redundant automated features protects the flight envelope from human error.
#4 Adverse Operating Conditions	Medium (3C)	The severity is determined to be **major** based the potential for adverse weather conditions during seasonal crop spraying operations. With the added mitigations in place, the likelihood is **extremely remote.** Operations will occur in VMC conditions only. The PIC and the VOs are trained to identify critical environmental conditions and to avoid them. The T-16 has Long-range visible, high intensity LED lighting. All T-16 come with mounted navigation lights in a standard configuration to indicate orientation and health. DJI Agras offers optional Long-range visible,

		high intensity LED strobes. Back 4 are white. Front right are green. Front left are red. Further, the use of high-visibility paint will be used on the aircraft to increase conspicuity in order to facilitate rapid identification of the UAs. Environmental conditions for safe operations are defined, measurable and adhered to with up to date weather forecasts and vigilance during flight operations. In the event of a weather degradation event, the PIC will land the aircraft.
#5 Unable to maintain VLOS	Medium (3C)	The severity is determined to be **major.** The PIC and VOs are properly trained in §§ 91.111, 91.113, and 91.115, and 107.37 and the PIC and VO will be positioned at visual vantage points in the operations area when a VO is required. However, the PIC will maintain VLOS with the UAs at all times. With the added mitigations in place, the likelihood is **extremely remote.** Time of day operating restrictions and restricting operations within certain boundaries or airspace volumes minimizes this risk. Operations will be restricted in time and flight termination will occur in the event the PIC is unable to maintain VLOS with the UAS during flight. The aircraft features an automatic kill switch as well.

Additional Safety Control and Residual Safety Risk

Hazard	Additional Controls	Severity	Likelihood	Residual Risk Level
#1 Technical Issue with UAS	No flights around other manned aircraft. Emergency procedures in place and validated. Training on multiple aircraft operations completed for all crewmembers as well as conspicuous lighting and high visibility paint.	Major	Extremely Remote	Green (3D)
#2 Deterioration of external systems supporting the UAS operation	If at any time there is a question that the UAS is no longer flying its programmed mission, the PIC will take manual control of the UAS and return it to the landing zone immediately under manual control.	Minor	Extremely Remote	Green (4D)
#3 Human Error	Recurrent human factors training. Pre and post flight briefings and lessons learned.	Minor	Extremely Remote	Green (4D)
#4 Adverse Operating Conditions	UAS designed and qualified for adverse environmental conditions	Major	Extremely Remote	Green (3D)

#5 Unable to maintain VLOS	Corrective lenses, glasses, and contact lens are allowed. Binoculars, telephotos lens, night vision goggles, and field glasses are allowed as augmentation devices. All supported operations will be conducted in VMC.	Major	Extremely Remote	Green (3D)



Severity / Likelihood	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A	[Green]	[Yellow]	[Red]	[Red]	[Red]
Probable B	[Green]	[Yellow]	[Yellow]	[Red]	[Red]
Remote C	[Green]	[Green]	[Yellow]	[Yellow]	[Red]
Extremely Remote D	[Green]	[Green]	[Green]	[Yellow]	[illegible]
Extremely Improbable E	[Green]	[Green]	[Green]	[Green]	[Yellow]

High Risk [Red]
Medium Risk [Yellow]
Low Risk [Green]

* High Risk with Single Point and/or Common Cause Failures

The completed analysis reflects no residual risk levels of medium or high and in addition to this SRM, all Ohana Drone UAS flight operations will comply with provisions in the FOPM, Aircrew Training Manual, and SMS to assure all current risk controls are valid and adequate.